

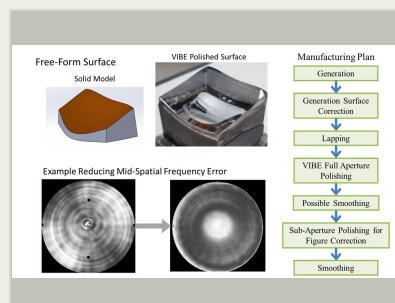
Manufacture of Free-Form Optical Surfaces with Limited Mid-Spatial Frequency Error, Phase I

Completed Technology Project (2014 - 2014)



Project Introduction

Our proposed innovation is a robust manufacturing process for free-form optical surfaces with limited mid-spatial frequency (MSF) irregularity error. NASA and many others have a direct and critical need for high quality free-form optical components. Free-forms can improve the optical performance of many types of optical systems when compared to aspheres. MSF error is a major concern with free-form optics as the standard method for manufacturing free-forms (sub-aperture tool polishing) can lead directly to large MSF error. Simply, MSF error is a height error on the surface in the spatial regime between roughness (micro) and irregularity (macro). MSF errors dramatically degrade performance in optical systems. Our free-form manufacturing process is differentiated by full-aperture polishing step, called VIBE, and by the proposed smoothing step. The VIBE step does not create MSF error as the sub-aperture process does. The smoothing step will reduce any inherent MSF error. In this manner, we will manufacture free-form optical surfaces without MSF errors. Our technical objectives are three fold: 1) Determine most feasible smoothing parameters, 2) Determine feasibility of smoothing for free-forms for reduced mid-spatial frequency error, and 3) Determine the effectiveness of using a computer generated hologram (CGH) for free-form measurements. To accomplish these objectives we have set out the following work plan. First we will design the free-form surface and the associated CGH (with feature for easy alignment). Next, we will perform a study on smoothing to determine the optimized smoothing parameters to remove mid-spatial frequency errors on free-form surfaces. Then, we will manufacture precision free-form surfaces using the optimized parameters. During each step in the manufacturing process (generation, VIBE polishing, smoothing, sub-aperture figure correction, and something) we evaluate both the irregularity and mid-spatial frequency errors.



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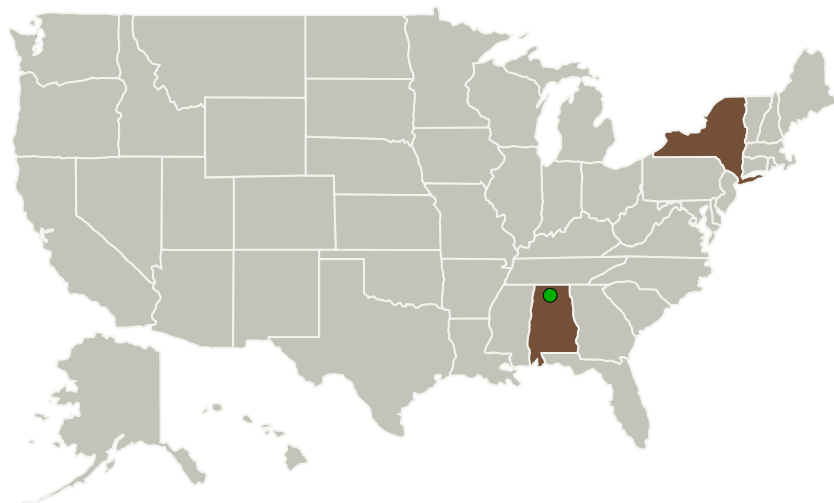
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Optimax Systems, Inc.	Lead Organization	Industry	Ontario, New York
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

Alabama	New York
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Project Transitions



June 2014: Project Start



December 2014: Closed out

Closeout Summary: Manufacture of Free-Form Optical Surfaces with Limited Mid-Spatial Frequency Error, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image(<https://techport.nasa.gov/file/137652>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Optimax Systems, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

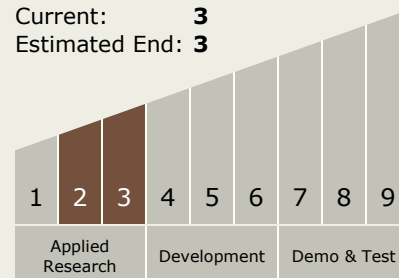
Carlos Torrez

Principal Investigator:

Katherine M Medicus

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**

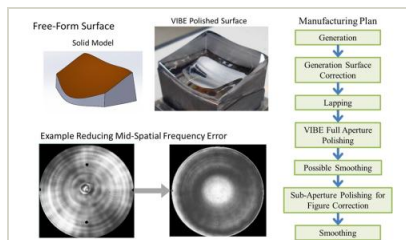


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Images



Briefing Chart Image

Manufacture of Free-Form Optical Surfaces with Limited Mid-Spatial Frequency Error, Phase I
(<https://techport.nasa.gov/image/132719>)

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - └ TX08.2 Observatories
 - └ TX08.2.1 Mirror Systems

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System